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(71) Applicant:

C CONTAINER-ZU JAPAN KK

(72) Inventor:

JIYON HORUMUSU UOOKAA

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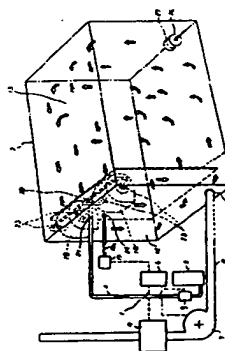
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SYSTEM FOR FUMIGATING CARGO IN CONTAINER FOR TRANSPORTATION THEREOF

(57) Abstract:

PURPOSE: To enable fumigation of cargoes in a container in the container by connecting a fumigant-charging pipe, device for measuring fumigant concentration and exhaust tube equipped with a device for removing injurious components to the container for transporting the cargoes and equipping the container with a controller for operation at the same time.

CONSTITUTION: A container 2 for transporting cargoes is equipped with a fumigant-charge opening 21, exhaust opening 25, outside aircharge opening 26 and insertion opening 24 for a device for measuring fumigant concentration and a fan equipment 18 for air circulation is attached to the inside of the container. A source of fumigant-supply 3 is connected through a pipe 4 to the fumigant-charge opening 21 and an air exhauster 7 and a device 9 for removing injurious components are connected through a pipe 8 to the exhaust opening 25. A terminal unit for measurement of the device 10 for measuring fumigant concentration is inserted from the insertion opening into the inside of the container. The fumigant supply and operation of the air exhauster 7 are controlled by a controller 6 based on a measured value thereby.



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[54] Title of Invention: FUMIGATION SYSTEM FOR LOADS IN SHIPPING CONTAINERS

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[72] Inventor: John Holmes Walker

1 Beachy Way, Blackmoor End, Westthamptstead, Hertfordshire AL4 8LY UK

[71] Applicant: Sea Containers Japan KK

5-1, Moto Akasaka 1 chome, Minato-ku, Tokyo

[74] Agent: Kyoza Yuasa, Patent Attorney, and four others

SPECIFICATIONS

1. Title of the Invention

Fumigation system for loads in shipping containers

2. Claims

(1) A fumigation system for loads in shipping containers consisting of a shipping container possessing a fumigant introduction port, an exhaust port, an external air introduction port, and a port for the insertion of a device for measuring the concentration of fumigant, and a fan device for circulating air within the container, and of a fumigation apparatus possessing a fumigant supply source, a fumigant supply tube that links said fumigant supply source and said fumigant introduction port, a fumigant concentration measurement device that is inserted into said insertion port, an exhaust device, an exhaust tube that links said exhaust port to said exhaust device, a toxic component removal device that removes toxic components from the exhaust gas that is exhausted through said exhaust device, and a control device that controls the amount of said fumigant that is supplied on the basis of the readings from said fumigant

concentration measurement device and that also controls the actions of the exhaust device and said toxic component removal device

3. Detailed Description of the Invention

Field of application in industry

The present invention relates to a fumigation system for shipping containers for the efficient fumigation of the cargoes carried in shipping containers.

Prior art

Over recent years, reefer containers that have built-in refrigeration equipment within the containers have been employed for the sea-borne shipment of bananas, pineapples and citrus fruit and the like. The cargoes of bananas and the like that are carried in such reefer containers must be fumigated according to the quarantine laws of each country.

Hitherto, in order to fumigate the cargoes in such containers, it has been necessary either to remove the cargoes from the containers and to transport the cargoes into the interiors of special fumigation facilities, or alternatively to open up the containers with the cargoes still inside and to introduce fumigants into the interiors of the containers.

Problems addressed by the present invention

However, of such methods of fumigation of the prior art, the former method requires that the cargoes be unloaded from the containers and be transported to a fumigation facility, and thus suffers the deficiencies of requiring considerable labour, expense and time until the completion of the fumigation work. Moreover, the latter method of fumigation requires that operators disperse the fumigant through each container, and hence the efficiency of the work of fumigation is low, while it is also impossible to precisely control the concentration and state of dispersal of the mixed gas formed by the air and fumigant within the container, and hence this method suffers the deficiency that the cargoes in the containers may not necessarily be fully fumigated.

It is thus an objective of the present invention to provide a fumigation system for the cargoes in shipping containers, such system enabling the efficient and precise fumigation of large volumes of cargo.

Means employed in order to resolve such problems

In order to achieve the aforementioned objective, the fumigation system for the cargoes in shipping containers envisaged by the present invention employs the following constitution. Namely,

A fumigation system for loads in shipping containers consisting of a shipping container possessing a fumigant introduction port, an exhaust port, an external air introduction port, and a port for the insertion of a device for measuring the concentration of fumigant, and a fan device for circulating air within the container, and of a fumigation apparatus possessing a fumigant supply source, a fumigant supply tube that links said fumigant supply source and said fumigant introduction port, a fumigant concentration measurement device that is inserted into said insertion port, an exhaust device, an exhaust tube that links said exhaust port to said exhaust device, a toxic component removal device that removes toxic components from the exhaust gas that is exhausted through said exhaust device, and a control device that controls the amount of said fumigant that is supplied on the basis of the readings from said fumigant concentration measurement device and that also controls the actions of the exhaust device and said toxic component removal device

Action

In the system for fumigating cargoes possessing such constitution as envisaged by the present invention, the shipping containers that have been unloaded from a container vessel onto the wharf are successively arranged in the vicinity of fumigation facilities that are provided on the container wharf. Then the fumigant supply tube of the fumigation device is connected to the fumigant introduction port in each container and the exhaust tube of the fumigation device is connected to the exhaust port in each container, and the fumigant concentration measurement device is inserted into the insertion port for the fumigant concentration measurement device in each container. With this, the preparation for fumigation is complete.

The fumigation of the load is performed in the following manner. First, with the fan device that is built into the interior of each container operating, the fumigant is supplied into the container. The fumigant flows from the fumigant supply source of the fumigation device through the fumigant supply tube into the interior of the container and mixes with the air therein, and is circulated by the fan device within the container. The concentration of the fumigant inside the container is monitored either continuously or at fixed intervals of time. On the basis of such readings, the control device controls the amount of fumigant that is supplied into the container.

Next, at the completion of the specified fumigation time, the control device stops the supply of the fumigant, and starts up the exhaust device and the toxic component removal device. The operation of the exhaust device produces a negative pressure in the interior of the container, and the external air introduction port is opened and external air flows into the container. The mixed gas consisting of air and the fumigant inside the container passes through the exhaust port and reaches the toxic component removal device where the toxic components of the mixed gas are removed, whereupon the gas is vented to the atmosphere. The concentration of the fumigant inside the container is gradually reduced through the inflow of the external air. The fluctuations in the concentration of the fumigant are monitored by means of the fumigant concentration measurement device, and when the concentration of the fumigant within the container has reached or fallen below the required level, the control device stops the operation of the exhaust device and the toxic component removal device. In this manner fumigation is completed.

Practical embodiment

The following is a description of a practical embodiment of the present invention by reference to the drawings.

Figure 1 is a drawing showing a schematic outline of the cargo fumigation system envisaged by the present invention, wherein shipping container 2 is connected to fumigation device 1.

Fumigation device 1 possesses a fumigant tank 3 that acts as the fumigant supply source, and fumigant supply tube 4 is connected to such fumigant tank 3. The flow volume control valve 5 is disposed in fumigant supply tube 4, and flow volume control valve 5 is linked to control device 6. *Fumigation device 1 also possesses an exhaust device 7, and exhaust device 8 is disposed at a point on the length of exhaust tube 9. Toxic component removal device 9 is disposed in the downstream portion of exhaust tube 8, and toxic component removal device 9 and exhaust device 7 are connected to control device 6.* Reference numeral 10 indicates the fumigant concentration measurement device, and this device 10 also forms a portion of fumigation device 1. Fumigation concentration measurement device 10 is also connected to control device 6, while fumigant introduction tube 10a is mounted on the other end of device 10.

Fumigation device 1 must possess a constitution that renders it suitable for installation and operation in an outdoor environment such as at a container wharf or a railway station, and it is desirable that the device should also be simple to use. It is desirable that the capacity of

fumigation device 1 should be sufficient to enable the simultaneous fumigation of a plurality of reefer containers.

The fumigant that is stored in the fumigant tank may be any fumigant gas that is commonly employed for the fumigation of bananas and pineapples and the like, such as for instance hydrocyanic acid gas (HCN) or methyl bromide (CH_3Br) and the like.

Shipping container 2 is a reefer container that possesses a built-in refrigeration unit. The interior of container 2 is partitioned by walls into a cargo section 13 and a refrigerator section 14, and two sections 13 and 14 are linked by an overhead loop 15 through which the refrigerant circulates. A plurality of cargo support members 16 that are formed of projecting rods having a T section is disposed on the floor of cargo section 13. The bottom of cargo section 13 and the bottom of refrigerator section 14 communicate with each other through a plurality of slits 16a that are formed between the projecting rods of cargo support members 16. Slits 16a extend over the entire longitudinal length of cargo section 13. In Figure 2, W represents the cargo to be fumigated that is held in cargo section 13.

Refrigeration unit 17 and air circulation fan devices 18 and 18 are disposed in refrigeration section 14, fan devices 18 and 18 being mounted in stand 19 that adjoins loop 15. Air passage 19a is formed inside stand 19, and air passage 19a communicates with air channels 20 and 20 that are formed on either side of refrigeration unit 17.

Fumigant introduction port 21 is disposed between fan devices 18 and 18, and fumigant introduction port 21 communicates through fumigant distribution tube 22 with the intake venturis (not shown) of fan devices 18 and 18. Spray heads 23 are disposed in the communicating part between distribution tubes 22 and the intake venturis of fan devices 18. Spray heads 23 spray the fumigant whereby the efficiency of the mixing of the fumigant and the air is enhanced.

Insertion port 24 for the fumigant concentration measurement device is disposed in the vicinity of fumigant introduction port 21 in container 2. Insertion port 24 may be situated at any position from which accurate measurements of the concentration of the fumigant inside the container may be made, but it is desirable that such location facilitate insertion for reasons of the insertion of fumigant introduction tube 10a of fumigant concentration measurement device 10.

An exhaust port **25** is also provided in container **2**. Exhaust port **25** may be located at any point from which the air containing the fumigant within the container can efficiently be exhausted from the container, but for reasons of the connection of fumigation unit **1** to container **2**, it is desirable for reasons of efficiency that it be placed in the same surface as that in which fumigant introduction port **21** and insertion port **24** for the fumigant concentration measurement device are placed.

External air introduction port **26** is so positioned as to face cargo section **13** of container **2**, and a one-way valve **27** is disposed in external air introduction port **26**. Such one-way valve **27** is released when the negative pressure within the container has reached a specified level, and the inflow of external air only from the exterior of container **2** to the interior of container **2** only is permitted.

The following is a description of the action of the foregoing practical embodiment.

Shipping containers **2** that has been unloaded from the container vessel onto the container wharf are successively arranged in the vicinity of the fumigation facility that is provided at the container wharf or railway cargo yard or the like. Next, fumigant supply tubes **4** of fumigation unit **1** are connected to fumigant introduction ports **21** of containers **2**, and exhaust tubes **8** of fumigation unit **1** are connected to exhaust ports **25** of containers **2**. Fumigant introduction tubes **10a** of fumigant concentration measurement devices **10** are also inserted into insertion ports **24** for the fumigant concentration measurement devices in containers **2**.

The fumigation of the cargo to be fumigated **W** is performed in the following way.

First, with fan devices **18** and **18** that are built into the interior of each container operating, control device **6** releases flow volume control valve **5** that is disposed in fumigant supply tube **4** and the fumigant is supplied into containers **2**. The fumigant flows from fumigant supply source **3** of fumigation device **1** through fumigant supply tube **4** into fan devices **18** and **18**. The fumigant that flows into fan device **18** passes through the device **18** and mixes with the air in container **2**, and is circulated by fan device **18** within container **2**. The white arrows in the drawing indicate the direction of circulation of the air in which the fumigant is mixed. Thus the air in cargo section **13** passes through loop **15** and flows into refrigeration section **14** and flows from the sides of fan devices **18** and **18** into fan device **18**. The air in which the fumigant is mixed then flows out from fan device **18** and passes through air passages **19a**, air channels **20** and slits **16a** and flows into cargo section **13**.

The air in which the fumigant is mixed inside container 2 is led by means of the fumigant introduction tube that is inserted into container 2 into fumigant concentration measurement device 10, and fumigant concentration measurement device 10 monitors the fumigant concentration either continuously, or alternatively, at fixed intervals of time. The readings for the concentration of fumigant that are made by fumigant concentration measurement device 10 are supplied to control device 6 and the control device adjusts the degree of opening of flow volume control valve 5 on the basis of these readings. In this manner, the concentration of fumigant inside container 2 is maintained at the specified value.

Next, when the specified fumigation time has elapsed, control device 6 closes flow volume control valve 5 and stops the supply of the fumigant. Exhaust device 7 and toxic component removal device 9 are then started up. The operation of exhaust device 7 creates a negative pressure inside container 2 and one-way valve 27 is released, and external air flows into container 2 through external air introduction valve 26. The mixture of fumigant and air inside container 2 passes through exhaust tube 8 and reaches toxic component removal device 9 where the toxic components are removed from the gases and the gases are then vented to the atmosphere. The residues that are removed by toxic component removal device 9 are securely stored in fumigation device 1, and are collected and disposed of at an appropriate time. In the process of exhausting the container, the concentration of fumigant in container 2 is gradually reduced through the inflow of external air, and the fluctuations in the concentration of the fumigant are monitored by fumigant concentration measurement device 10. When the concentration of fumigant inside container 2 has reached, or fallen below, a specified level, control device 6 halts the operation of exhaust device 7 and toxic component removal device 8, and in this manner the fumigation process is completed.

In this practical embodiment of the invention, container 2 is a reefer container, but a reefer container need not be employed, provided that air circulation fan devices are provided. However, because the built-in refrigeration unit in a reefer container is able to control the temperature of the air that circulates in the container, the refrigeration unit is able to optimise the temperature of the air at which the fumigant that is used is dispersed.

Effects of the invention

The present invention of a fumigation system for shipping containers as described in the foregoing enables the fumigation of the cargo while it is still inside the container, and because the present invention enables the accurate regulation of the concentration of the fumigant inside the container, the present invention provides the advantage of permitting the fumigation of large volumes of cargo very efficiently and securely.

4. Simplified description of the drawings

Figure 1 is an oblique view showing a the schematic constitution of the fumigation system for shipping containers envisaged by the present invention, and

Figure 2 is an oblique view of the essential elements of the fumigation system for shipping containers envisaged by the present invention.

1 ... Fumigation device, 2 ... Container, 3 ... Fumigant supply source, 4 ... Fumigant supply tube, 5 ... Flow volume control valve, 6 ... Control device, 7 ... Exhaust device, 8 ... Exhaust tube, 9 ... Toxic component removal device, 10 ... Fumigant concentration measurement device, 11 ... Refrigeration unit, 12 ... Wall, 18 ... Fan device, 21 ... Fumigant introduction port, 24 ... Insertion port for fumigant concentration measurement device, 25 ... Exhaust port, 26 ... External air introduction port, 27 ... One-way valve

Agent: Kyozo Yuasa, Patent Attorney, and four others

Voluntary amendment (formal)

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Mr F. Yoshida
Director, Patent Office

1. Statement of matter
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2. Title of Invention
Fumigation System for Loads in Shipping Containers

3. Party making Amendment
Standing in matter: Applicant

Address:
Name: Sea Containers Japan KK

4. Agent
Address: 206 Shin Otemachi Building, 1-2 Otemachi 2-chome, Chiyoda-ku, Tokyo
Name: Kyoze Yuasa, Patent Attorney

5. Date of Instruction to Amend: (Sent on) September 27 1988

6. Subject of Amendment
Corrected drawings

7. Contents of Amendment
See attached (no change to contents)

(Seal: Patent Agency, 20/10/1988)